

*Selected, quality filtered, not subject to external review

POLICY ISSUES:

I. VHA's Office of Patient Care Services (OPCS) requested a review of new technologies for home telehealth. Since clinical research on novel information technologies (or new uses of established ones) inevitably will lag behind technology availability, TAP expanded its charge to an overview of systematic reviews for home telehealth.

The purpose of VHA's national home telehealth program, Care Coordination/Home Telehealth (CCHT), is *"to coordinate the care of veteran patients with chronic conditions and avoid the unnecessary admission to long-term institutional care"* (Darkins, 2008).

II. OPCS also asked that TAP identify current business or marketplace issues for home telehealth, providing a global overview of the telemedicine, E-health, mobile health, telehealth, and personal E-health technologies marketplaces, including information and resources on the market leaders, potential partners, and future trends. Accordingly, this review is organized in two parts:

- **Part I:** published research evidence on the effectiveness or cost-effectiveness of home telehealth to improve patient outcomes.
- **Part II:** business/marketplace trends and issues for telemedicine.

Definition: TAP will borrow the definition of home telehealth supplied by Tran (2008):

"...Home telehealth, which includes home telemonitoring and telephone support, brings health care delivery to the patient's home by connecting the patient and a health care professional; telemonitoring is remote delivery or monitoring that occurs between the health care provider and patient and involves the transmission of patient outcome data to the provider from a remote location; it can be synchronous (real-time) or asynchronous (not real-time or store-and-forward telemedicine). Synchronous technologies include audio and video conferencing. Asynchronous involve the storage of clinical digital samples and relevant data, which are forwarded to a health care professional at a distant site by email or the Internet using video clips or other forms of data transmission. The infrastructure for home telemonitoring consists of client devices (software, hardware, and services to assist in patient monitoring), central systems to manage client information, a communication network, provider devices, and care team activities (software and hardware to facilitate client-to-provider and provider-to-provider information sharing). Telephone support is patient or caregiver support, such as advice, education, or follow-up by a health care provider, that is usually provided by telephone contact."

PART I: SYSTEMATIC REVIEWS FOR HOME TELEHEALTH: STATE OF THE EVIDENCE

Methods: TAP first identified available systematic reviews, then updated review searches to confirm the presence or absence of subsequently published review-eligible primary research that would change review conclusions. TAP searched Medline, Embase, Cochrane, and INAHTA databases using “telehealth”, “chronic diseases” and “systematic review” or “meta-analysis”.

Included

Systematic reviews and subsequently published eligible studies; comparative studies; and cost studies or economic evaluations in adults and peer-reviewed published in English from 1990 to 2010.

Excluded

- Narrative reviews, letters, and other publications lacking primary patient-based data and/or explicit methods descriptions.
- Home telehealth among interventions but not separately reported.
- Articles judged unintelligible by at least two TAP staff.
- Inaccurately indexed or otherwise irrelevant to our charge.
- Laboratory or other pre-clinical studies.
- Primary studies already covered in systematic reviews.
- Preliminary publications including: Cochrane protocols; abstracts; pilot/feasibility/demonstration projects.
- Duplicate or previous publications of same material.
- Quasi-systematic” reviews, i.e., those which on careful reading fail to meet criteria (below) or are inadequately reported to judge; quasi systematic reviews may attend to some details of truly systematic methods but miss their essential spirits of critical analysis and transparent reporting.

Literature appraisal

The progression of epidemiologic studies, or the epidemiologic study cycle, confirming the existence and magnitude of an association between exposure and disease or intervention and outcome is well-documented (Ibrahim, 1985; Mausner and Kramer, 1985; Lilienfeld and Stolley, 1994; Muir Gray, 1997): it begins with observational, hypothesis-generating studies such as single case or case series reports, then on to cross-sectional (also known as survey, correlational, or ecological) studies, which ascertain exposure and disease in populations at the same point in time, then progresses through analytic, hypothesis-testing studies (case-control or cohort, from which relative risk or estimates can be calculated), and culminates in the randomized controlled trial confirming causality.

The systematic review synthesizing multiple primary studies provides an ultimate level of evidence, as do economic evaluations using efficacy data from reviews, and ideally collecting resource data during the course of randomized trials that also supplied causal evidence.

Systematic reviews

Systematic reviews (detailed below) qualify as reproducible science and their production requires a threshold level of available primary research. Published systematic reviews thus provide an immediately accessible overview of the general status of a body of research literature. Conversely, the lack of published high-quality systematic reviews indicates a corresponding lack of published research.

Cook (1995 and 1997) defines systematic reviews: “*Systematic reviews are scientific investigations in themselves, with pre-planned methods and an assembly of original studies as their “subjects”. They synthesize the results of multiple primary investigations by using strategies that limit bias and random error...*”

The same authors further specify characteristics of systematic reviews and contrast them with traditional narrative reviews: the latter synthesize articles without reporting methods of selection or quality assessment criteria and thus do not qualify as reproducible unbiased science.

Systematic reviews:

- Ask a focused clinical question;
- Conduct a comprehensive search for relevant studies using an explicit search strategy;
- Uniformly apply criteria for inclusion and exclusion of studies;
- Rigorously and critically appraise included studies;
- Provide detailed analyses of the strengths and limitations of included studies.

Results: TAP’s searches identified a total of 433 citations, of which only 16 (Table 1) met inclusion criteria and are abstracted in detail in Table 2.

Table 1. Overview of available systematic reviews, economic studies, and subsequently published eligible primary studies

Citation	Content	Setting/search coverage
Systematic reviews		
Polisena (2010)	COPD	1998-
Whittaker (Cochrane; 2009)	Smoking cessation	-2009
Polisena (2009a)	Diabetes	-2008
Hailey (2008)	Mental health	- 2006
Tran (CADTH; 2008)	Chronic diseases	-2008
Paré (2007)	Chronic diseases	-2006
Barlow (2007)	Frail elderly/chronic diseases	-2006
García-Lizana (2007)	Chronic diseases	-2005
Hersh (AHRQ; 2006)	Medicare population	-2004
Economic studies		
Bendixen (2009)	Telerehab for chronically ill or disabled elderly	VA
Polisena (2009)	Cost-effectiveness for chronic diseases	-2008
Subsequently published review eligible		
Stone (2010)	Diabetes	VA

Bibliography*: Home Telehealth

Citation	Content	Setting/search coverage
Huanguang (2009)	Preventable hospitalization for conditions manageable in ambulatory care	VA
Dansky (2008)	Heart failure	RCT: 10 US home health agencies
Darkins (2008)	Chronic conditions	VA
Wakefield (2008)	cardiac disease patients at high risk of readmission	RCT: Canadian academic medical centers
Woodend (2008)	Cardiac disease	Canada

Table 2. Abstracted details of Table 1 (included) studies

Citation	Design/methods	Results/Conclusions
Polisena (2010)	Home telephone support for COPD Vs usual care: <ul style="list-style-type: none"> Multiple databases, 1998- 2009; RCTs or observational studies reporting QoL or healthcare utilization; Excluded: no comparison group; wrong intervention; Quality assessment by Hailey tool (A-E on items for design, reporting, confidence in findings); Meta-analysis where pooling judged appropriate. 	9 studies (858 subjects): <ul style="list-style-type: none"> Quality ratings A-D; FU, 3-19 months; N America, Europe, Australia, China; 18-191 subjects; including > 60 years in all studies; Heterogeneity precluded pooling results Hospitalizations (2 RCTs): both significant decreases in frequency of admission; ED visits: 1 RCT found significant decrease; Meta-analysis for mortality: NS higher risk for intervention (RR, 1.21; CI, 0.84-1.75). <p>Conclusions: "Clinical heterogeneity was found in many of the outcomes measured. Home telehealth (home telemonitoring and telephone support) was found to reduce rates of hospitalization and emergency department visits, while findings from hospital bed days of care varied between studies. However, mortality was greater in the telephone support group compared with usual care (RR, 1.21; CI, 0.84-1.75). Home telehealth interventions were similar to or better than usual care for quality of life and patient satisfaction outcomes."</p>
Bendixen (2009)	VHA LAMP program for telerehabilitation: <ul style="list-style-type: none"> Telerehab program using combination of traditional and advanced technologies to promote independent living safely at home; Coordination by occupational therapists; Interventions: assistive/adaptive technologies; modification of home environment; daily therapeutic regimens for ADLs; Target population: veterans with multiple comorbidities; diabetes; hypertension; stroke; Eligibility: living at home with phone and electricity services; functional deficit in at least 2 ADLs; informed consent; Population source: 75,714 veterans in Large Health Study (LHVS); compared to 2005 outpatient data. 	Full baseline data for 65,756 veterans in LAMP program (202 CCTH); 46,267 outpatient comparison subjects: <ul style="list-style-type: none"> NS baseline demographic or diagnosis differences; Cross-sectional analysis: CCTH vs usual care: NS cost differences (1 year pre and 1 yr post intervention); LAMP program: increased clinic visits but decreased hospital/nursing home LOS post-intervention. <p>Conclusions: "LAMP interventions drive up short-term costs but long-term benefits (avoidance of heart attack, stroke, or amputation) may take years to manifest...future research should consider using a randomized controlled trial design, following intervention and control groups for more than 12 months, analyzing differential use of VA services, and studying the different CCTH models using teams of nonmedical and medical care coordinators."</p>
Whittaker (Cochrane; 2009)	Are mobile phone-based interventions effective at helping smokers to quit?	4 trials: <ul style="list-style-type: none"> Text message programs (New Zealand and UK); internet plus phone (2 groups in Norway);

Citation	Design/methods	Results/Conclusions
	<ul style="list-style-type: none"> Multiple databases, inception-2009; RCTs or quasi-randomized; CCTs; before-and-after; interrupted time series enrolling adults > 18 living at home or in community setting; Interventions: social alarms; electronic assistive devices; telecare social alert platforms; environmental control systems; automated home environments; Excluded: mobile phones as adjunct to face-to-face or Internet based programs (appointment reminders or where components of multi-faceted interventions could not be distinguished); Quality assessment by Jaddad scale. 	<ul style="list-style-type: none"> Text message Pooled results: significant increase in self-reports of quitting (RR, 2.8; CI, 1.80-2.65) but considerable heterogeneity in long-term results (larger trial had problems with misclassification of outcome; not included in meta-analysis); Internet plus phone programs: increased short- and long-term self reports of quitting (RR, 2.03; CI, 1.40-2.92). <p>Conclusions: <i>"The current evidence shows no effect of mobile phone-based smoking cessation interventions on long-term outcome. While short-term results are positive, more rigorous studies of the long-term effects are needed."</i></p>
Polisena (2009)	<p>Home telehealth for chronic disease management:</p> <ul style="list-style-type: none"> Multiple databases, 1998-2008; Economic evaluations (including cost studies with assumption that telehealth at least as effective as usual care); Quality assessment by modified Drummond scale for economic evaluations. 	<p>22 studies:</p> <ul style="list-style-type: none"> Majority from US; others from Italy, Spain, UK, Canada; 21 studies were simple cost analyses, one cost-utility study; Heterogeneity precluded meta-analysis. Most focused on CHF; other diagnoses included diabetes, COPD; or multiple including CHF or COPD; Usual care variably defined: organized home care, other support program, or MD-directed care with/without home care; Results inconsistent and study quality poor. <p>Conclusions: <i>"Current evidence suggests that home telehealth has the potential to reduce costs, but its impact from a societal perspective remains unclear until higher quality studies become available."</i></p>
Polisena (2009a)	<p>Home telehealth (telemonitoring or telephone support) vs usual care for diabetes:</p> <ul style="list-style-type: none"> Multiple databases, 1998-2008; RCTs or observational studies enrolling patients with diabetes, comparing telehealth to usual care, and reporting health service utilization, glycemic control or QoL; 	<p>21 studies for telemonitoring; 5 for telephone support (5069 patients):</p> <ul style="list-style-type: none"> 12 RCTs; 9 observational; Variable quality; Hospitalization rates: 1 pre-post study (lower rates post; 1 observational (lower rate in telemonitored group); 1 RCT (lower rate with phone support; no data for telemonitoring vs usual care); ED visits: two observational studies (opposite results); 1 RCT (lower rate for telephone

Citation	Design/methods	Results/Conclusions
	<ul style="list-style-type: none"> Quality assessment by modified Hailey scale. 	<p>support;</p> <ul style="list-style-type: none"> Primary care visits: 2 observational (inconsistent results); Glycemic control: WMD, -0.21 (CI, -0.35—0.08) for telemonitoring; mixed results for phone support. <p>Conclusions: <i>"In general, home telehealth had a positive impact on numerous health services and glycemic control. More studies of higher methodologic quality are required to give more precise insights into the potential clinical effectiveness of home telehealth interventions."</i></p>
Hailey (2008)	<p>Effectiveness of telemental health (TMH) applications:</p> <ul style="list-style-type: none"> Multiple databases, -June 2006; English-language controlled studies TMH Vs non-TMH alternative; Excluded: outcomes restricted to satisfaction, caregiver outcomes only; duplicate studies; reviews; CME; Quality assessment by scale for design, performance, reporting, and confidence decision makers could have in results: suitable for clinical use; promising; inadequate support for clinical use. 	<p>72 paper/65 studies:</p> <ul style="list-style-type: none"> Largest cluster of studies for TMH (usually video conferencing) for range of diagnoses; mostly poor-fair quality; Evidence of success for TMH in: child psychiatry; depression; dementia, schizophrenia, suicide prevention, PTSD, panic disorders, substance abuse, eating disorders, smoking prevention; other areas less convincing; 82% of studies advocated further study. <p>Conclusions: <i>"Evidence of benefit from TMH application is encouraging, though still limited. There is a need for more good-quality studies on the use of TMH in routine care. The emerging use of Internet-based applications is an important development that deserves further evaluation."</i></p>
Tran (CADTH; 2008)	<p>Examination of the literature and meta-analyses:</p> <ul style="list-style-type: none"> Use of health services. Outcomes for home telehealth (home telemonitoring and telephone support) Vs usual care. Cost-effectiveness/framework for economic evaluation Ethical, legal, psychosocial issues Patients with diabetes, COPD, CHF Multiple databases, 1998-2008; Study selection and quality criteria varied by issue: no global exclusions for design, 	<p>79 report/78 studies included:</p> <ul style="list-style-type: none"> Diabetes (26 studies); CHF (35); COPD (9); mixed diagnoses (8); Comparison group was usual care for all; Diabetes: Home telemonitoring provided better glycemic control and reduced re-hospitalizations; QoL and patient satisfaction similar; management strategies did not differ according to type of diabetes; CHF: telemonitoring or support reduced re-hospitalizations, all-cause mortality, bed days, and ED visits; NS differences for all-cause admissions, QoL, patient satisfaction; Mixed chronic diseases: reduced service use, lower mortality; NS differences in QoL or satisfaction; Economic studies: telehealth no less effective than usual care, but cost-saving from health system perspective.

Citation	Design/methods	Results/Conclusions
	<p>language or publication status;</p> <ul style="list-style-type: none"> Meta-analyses considered for studies with “C” or higher quality rating and low heterogeneity ($I^2 \leq 50$). 	<p>Conclusions: “Home telehealth is generally clinically effective and no included studies reported adverse events. Evidence for service utilization is more limited but shows potential in some studies. Home telehealth appears to be cost-saving but overall quality of studies was low.”</p>
Paré (2007)	<p>Home telemonitoring for chronic diseases:</p> <ul style="list-style-type: none"> Multiple databases, 1990-2006; English-language per-reviewed RCTs in patients with diabetes, hypertension, heart or pulmonary disease; Excluded: reviews; patients with multiple diagnoses; settings other than home care. 	<p>65 studies:</p> <ul style="list-style-type: none"> Magnitude and significance of effects for all diseases inconclusive; Regardless of nationality, socioeconomic status or age, patients comply with programs and use of technologies; Most consistently positive effects reported for: decreases in ED visits, hospital admissions and LOS in pulmonary and cardiac disease. <p>Conclusions: “Home telemonitoring in chronic diseases seems to be a promising approach that produces accurate and reliable data, influences attitudes and behaviors, and potentially improves clinical outcomes. Future studies need to build evidence on clinical effects, cost-effectiveness, impacts on service utilization, and acceptance by providers.”</p>
Barlow (2007)	<p>Home telecare for frail elderly and chronic conditions:</p> <ul style="list-style-type: none"> Multiple databases, - Jan 2006; RCTs or observational ≥ 80 patients receiving interventions including safety/security monitoring in home, vital signs monitoring, or information and support via telephone or Internet. 	<p>68 RCTs; 30 observational:</p> <ul style="list-style-type: none"> For diabetes (31% of studies) or heart failure (29%); Heterogeneity precluded meta-analysis; 2/3 of available studies conducted in US, most published 03-06; The most effective telecare interventions appear to be automated vital signs monitoring (to reduce service utilization) and telephone follow up by nurses (to improve clinical outcomes); Cost-effectiveness uncertain and very little information on home safety/security systems. <p>Conclusions: “Telecare can be seen as a new method of service delivery, supported by new technology and existing technology used in new ways. This makes it difficult to evaluate using conventional approaches.”</p>
García-Lizana (2007)	<p>Information and communication technology (ICT) interventions for chronic disease:</p> <ul style="list-style-type: none"> Medline, 1995-Jan 2005; English-language RCTs applying ICTs to adults with chronic diseases and reporting clinical or QoL outcomes. 	<p>24 studies (total N not reported; range/study, 15- 228):</p> <ul style="list-style-type: none"> Most studies reported NS differences in outcome although trends for hypertension and heart failure; No studies reported adverse effects; Few studies reporting satisfaction: good for both patients and providers. <p>Conclusions: “Overall, ICT applications did not show an improvement in clinical outcomes,</p>

Citation	Design/methods	Results/Conclusions
		<i>although no adverse effects were identified. However, ICTs used in the detection and follow up of cardiovascular diseases provided better outcome, mortality reduction and lower health services utilization. Systems for improving education and social support were also shown to be effective. At present the evidence about the clinical benefits of ICTs for managing chronic disease is limited."</i>
Hersh (AHRQ; 2006)	Telemedicine applications in the Medicare population (home-based only abstracted here) <ul style="list-style-type: none"> • Does home-based telemedicine result in comparable diagnostic decisions and recommendations for management? • Does home-based telemedicine result in comparable health outcomes? • Does the availability of home-based telemedicine improve access to care? • Multiple databases and hand-searching, -June 2004; • Studies relevant to research question; • Excluded: non-Medicare population; services not normally requiring face-to-face encounter (radiology or pathology) 	97 studies overall: <ul style="list-style-type: none"> • Most home-based telemedicine studies enrolled patients with chronic diseases (CHF, diabetes, CAD, hypertension); common characteristic was dedicated staff (usually RN) monitoring data recorded in the home and developed clinical management plan; some evaluated with small I problematic quality RCTs; • RCTs found improved outcomes with telemedicine but designs did not allow distinguishing benefits from those conferred by dedicated staff; • Chronic disease in the elderly: benefits (functional status, reduced ED/other hospital) for disease-specific dedicated programs; • Lack of studies on access to care. Conclusions: <i>"There are still significant gaps in the evidence base between where telemedicine is used and where its use is supported by high-quality evidence. Further well-designed and targeted research that provides high-quality data will provide a strong contribution to understanding how best to employ technological resources in health care."</i>

Table 3. Subsequently-published studies eligible for Table 1 reviews

Reference	Study design/Methods details/setting	Results/comments
Stone (2010)	RCT: short-term efficacy of active care management by NP with home telemonitoring Vs monthly care coordination by phone: <ul style="list-style-type: none"> • Veterans with type 2 diabetes and A1C\geq7.5%; • receiving primary care at VA Pittsburgh 2004-5; • both groups received monthly calls for education and self-management review; • Randomization by study statistician; 	150 patients (73 home telemonitoring; 77 care coordination): <ul style="list-style-type: none"> • Telemonitoring group had significantly larger decreases in A1 C at 3 months (1.7%Vs 0.7%) and 6 months (1.7Vs 0.8%) P<0.001 for both times; • Most improvement by 3 months. Conclusions: <i>Compared with care coordination, active management + telemonitoring produced significantly greater reduction in A1C by 3 and 6 months. However, both interventions improved glycemic control in primary care patients with previously inadequate control."</i>

Reference	Study design/Methods details/setting	Results/comments
	<ul style="list-style-type: none"> Sample size calculation for 1% difference and 80% power; ITT analysis. 	
Huanguang (2009)	Cross-sectional: long-term effects of home telehealth on preventable hospitalization <ul style="list-style-type: none"> VA CCHT for veterans with diabetes at 4 centers; 4 yrs FU; AHRQ definition of ambulatory care sensitive conditions 	387 CCHT cases and matched controls (no CCHT): <ul style="list-style-type: none"> During first 18 months CCHT enrollees less likely to be admitted for preventable hospitalization than controls; also higher rates of complications, amputations, uncontrolled diabetes, pneumonia, angina; Treatment group: CHF, COPD; dehydration. Regression analyses: significant differences ($p < 0.001$) in long-term complications, amputation, uncontrolled diabetes. Conclusions: <i>"The VA CCHT program for diabetes patients reduced preventable hospitalizations"</i>
Dansky (2008)	RCT: <ul style="list-style-type: none"> Home telehealth intervention (synchronous with video or asynchronous phone only) Vs routine home visits for CHF; Randomization by sealed envelope and non-random technology assignment by one of 10 participating home health agencies (US mid-Atlantic); Power calculation reported but could not recruit full sample; Baseline, 60-day and 120-day data collection; Logistic regression analyses. 	284 patients: <ul style="list-style-type: none"> NS disease or demographic differences at baseline; 120-day: telehome care group had greater LOS at home (69 Vs 62 days); Regression to predict likelihood of hospitalization, ED visit, or death: NS trend for lower hospitalization in telecare group over entire study duration, but not short term; Mean number of hospitalizations similar for both groups; Technology differences within telecare; patients with synchronous/video systems had lowest number of hospitalizations at both times but NS; controls highest number of hospitalizations. ED visits: lower for telecare than control but NS. Conclusions: <i>telehome care may reduce ED use or hospitalization although small sample made result non significant. Telehome care, as an intervention, improve quality of care because it provides frequent monitoring of clinical indices that signal changes in cardiac status..."</i>
Darkins (2008)	Before-and-after care coordination/home telehealth implementation in VHA: <ul style="list-style-type: none"> CCHT implementation 2003-7: 1500% growth in CCHT participation; 17,025 patients in 2008; Routine data collection for quality and performance reporting. 	Change: <ul style="list-style-type: none"> 25% reduction in bed days of care; 19% decrease in hospital admissions; Mean satisfaction 86%; Cost: \$1600/patient/year (< alternatives). Conclusions: <i>"Enterprise-wide home telehealth implementation is an appropriate and cost-effective way of managing chronic care patients in both urban and rural settings."</i>
Wakefield (2008)	RCT: home telehealth Vs usual care for FU after hospitalization for heart failure: <ul style="list-style-type: none"> VA patients randomized to telephone, 	148 randomized: <ul style="list-style-type: none"> Home-based telehealth resulted in significantly longer to readmission but no effects readmission rates or mortality;

Reference	Study design/Methods details/setting	Results/comments
	<p>videophone or usual care FU;</p> <ul style="list-style-type: none"> Randomization by sealed envelope; sample size calculation reported; Telephone group used existing home phone; videophone supplier change during trial. 	<ul style="list-style-type: none"> No differences in LOS or urgent care visits; All subjects (both groups) reported better QoL at 1 yr. <p>Conclusions: <i>There was evidence of the value of telephone follow-up, but there was no evidence to support the benefit of videotelephone over telephone care. Rigorous evaluation is needed to determine which patients may benefit from specific telehealth applications and which technologies are most cost-effective."</i></p>
Woodend (2008)	<p>RCT: telecare Vs usual care in patients with cardiac disease at high risk of readmission:</p> <ul style="list-style-type: none"> Patients with heart failure (NYHA class ≥II or scheduled for CABG) or angina; Videoconferencing (with RN for 3 months) and phone transmission of weight, BP, EKG; Post-hoc power calculation; N determined by number of telehealth systems available; No randomization procedure or blinding described. 	<p>249 patients:</p> <ul style="list-style-type: none"> 162 with anemia (#1), 132 without (#2); Intervention patients had higher NYHA class than control patients and more likely to have HF not angina; Mortality and loss to FU: NS difference; Hjome telecare significantly reduced readmissions and days spent in hospital for angina; QoL and functional status for HF; High patient satisfaction with telecare. <p>Conclusions: <i>"Telehealth technologies are a viable means of providing home monitoring to patients with heart disease at high risk of hospital readmission to improve their self-care abilities."</i></p>
Go (2006)	<p>Cross-sectional:</p> <ul style="list-style-type: none"> Hemoglobin (Hb), kidney function, and adverse events (death, hospitalization) in HF; Kaiser-Permanente (N CA)1996-2002; Longitudinal outpatient Hb, creatinine and GFR from K-P records; Mortality from state death records. 	<p>59, 722 adults with HF:</p> <ul style="list-style-type: none"> 46% female; mean age 72; Compared with Hb levels 213.0-213.9g/dl, multi-variable-adjusted risk for death increased with lower Hb: Hb 12.0-12.9, GR, 1.5(CI, 1.44-1.57); HB 11.0-11.9, HR, 1.89(1.80-1.98); Hb 10.0-10.9 (HR,2.31; 2.18-2.45); Hb 9.0-9.9 (HR, 2.31; 2.18-2.45, Hb< 9.0 (HR2.44; 2.28-2.61); Hb ≥17.0 (HR, 1.42; 1.24-1.63); Compared with GFR≥60 ml/min, those with GFR< 45ml/min: HR, 1.39 (1.34-1.44);< 44 (HR, 2.28(2.19-2.39) < 15 (HR, 3.26 ;3.05-3.49); on dialysis (HR, 2.44; 2.28-2.61); Relations similar for risk of hospitalization; Findings did not differ by level of LV function; Hb an independent predictor of outcome at all levels of kidney function. <p>Conclusions: <i>Very high (≥17.0 g/dL) or reduced (< 13g/dL) hemoglobin levels and chronic kidney disease independently predicted risks of hospitalization or death in heart failure, regardless of the level of systolic function. Randomized trials are needed to evaluate whether raising hemoglobin levels can improve outcomes in chronic heart failure."</i></p>

IN-PROGRESS RESEARCH

Tap searched www.clinicaltrials.gov on June 10, 2010 using “telehealth”. Among the 36 ongoing studies listed, those detailed in Table 4, once published, should contribute to the knowledge base for telehealth in chronic disease management as defined by the reviews included here.

Table 4: in-progress studies for home telehealth

Title/design	Sponsor/location	Projected completion (if noted)
COPD case management/ case series for efficacy and safety	VA Nebraska	2010
Home telehealth for CHF/RCT	Canada	2007
Effects of telehealth on rehospitalization and self-care in heart failure/RCT	NIH	2010
Home telehealth stroke care/RCT	VA	2011

CONCLUSIONS AND DISCUSSION

The literature on telehealth is vast and diffuse, with systematic reviewers culling through thousands of citations to arrive at trivial inclusion numbers. This size and scope is reflected in the often equally diffuse reviews. While all report methods in sufficient detail to qualify for inclusion here, a subset barely do: they lack focused questions and/or robust quality assessment for included studies, thus primarily supplying qualitative catalogues of primary study coverage rather than answers to defined questions.

Other TAP reviews relevant here and available on request include:

- Patient Centered Care (2006), which covers the effectiveness of self-management programs for chronic diseases;
- Nurse-led Primary care (2009), including telephone triage and support programs.

Among the reviewers planning statistical pooling of research results in meta-analyses, many ultimately opted against for reasons of heterogeneity; the few that did complete meta-analysis acknowledged substantial if not statistically impossible variations in study populations and telehealth interventions. TAP includes these reviews in spite of their limitations: the size and scope of available research provides answers of a kind, certainly guidance for a research agenda.

TAP’s focused searches resulted in a more manageable number of citations but similar conclusions on the state of the evidence: The quality, access, or cost benefits of telehealth interventions remain more potential than well-defined through rigorous research. VA’s ongoing research (Tables 1-4) will make important contributions.

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Table 5: Excluded articles
(detailed exclusion criteria on page 2)

Citation	Reason
Ditewig (2010)	Home telehealth not reported separately from other interventions
Bates (2010)	Narrative review
Luptak (2010)	VA demonstration/feasibility study
Wray (2010)	VA RCT but outside charge
Durrani (2009)	Outside charge
Bartoli (2009)	Quasi-systematic
Hill (2009)	VA but outside charge
Lutaz (2009)	Feasibility study
Martin (2009)	No telehealth interventions
Oddsson (2009)	Narrative review
DelliFraine (2008)	Covered by Polisena (2009a)
deJongh (2008)	Cochrane protocol
Vodopivec-Jamsek (2008)	
Barnett (2007)	not eligible for Polisena (2009)
Bensink (2007)	Incompletely reported
Chumbler (2007)	VA but feasibility study
Leibowitz (2007)	Outside charge
Rolland (2006)	Outside charge
Kerr (2004)	Narrative review
Montori (2004)	Covered by Polisena (2009a)
Duffy (2003)	Outside charge
Stacey (2003)	
Jennett (2003)	Covered by Hersh (2006)
Hailey (2003)	

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TAP staff person/position	Role	Responsibilities
Karen Flynn Program Manager Boston	Primary author	Conception and conduct of review: <ul style="list-style-type: none"> • Communication with client; • Clinical search strategy; • Interim information; • Analytic framework; • Draft review; • Final review.
Elizabeth Adams Health System Specialist Boston	Consultation throughout project	<ul style="list-style-type: none"> • Internal content and format review; • Confirmation of exclusion for unintelligibility.
Elaine Alligood Information Specialist Boston	Literature database searches	Database searches: <ul style="list-style-type: none"> • Design/conduct technical strategy; • Choose/manage databases; • Strategy text and references for report. • TAP library/archive.
Rebecca Morton Library Technician Boston	Article retrieval	Information retrieval: <ul style="list-style-type: none"> • Full text from print journals and electronic resources; • Manage reference lists.
Bernard Spence Administrative Officer Boston	Administrative support	<ul style="list-style-type: none"> • Budget/resources; • "intelligent lay reader" review; • Project tracking.

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